Ames

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO ATTN OF: GP

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U. S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code USI, the attached NASA-owned U. S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U. S. Patent No. : 3,584,311

Government or Corporate Employee : U.S. Government

Supplementary Corporate Source (if applicable) : NA

NASA Patent Case No. : ARC-10137-1

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:
Yes ☐ No ☒
Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of Column No. 1 of the Specification, following the words ". . . with respect to an invention of . . ."

Elizabeth A. Carter

Elizabeth A. Carter
Enclosure
Copy of Patent cited abov

FACILITY FORM 602

N71-28468 (ACCESSION NUMBER)
(THRU)
3 (PAGES)
00 (CODE)
(NASA CR OR TMX OR AD NUMBER)
09 (CATEGORY)

N71-28468

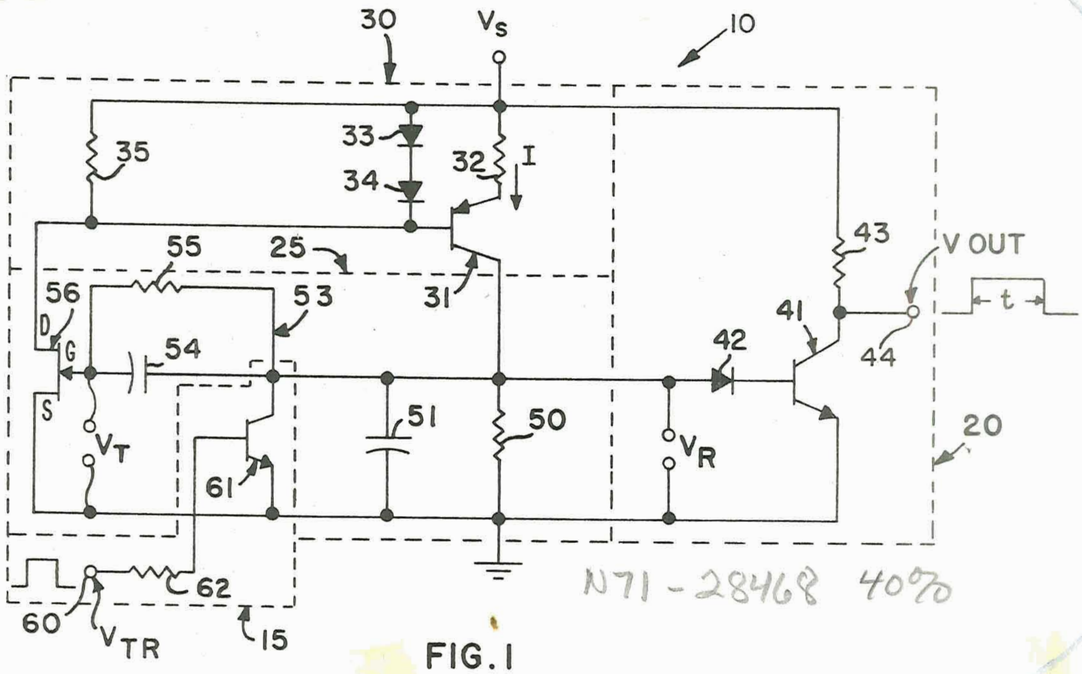


FIG. I

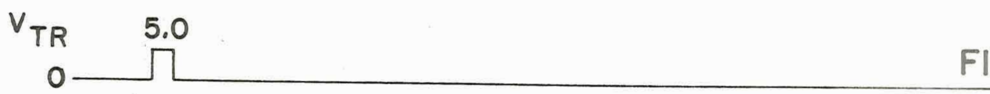


FIG. 2

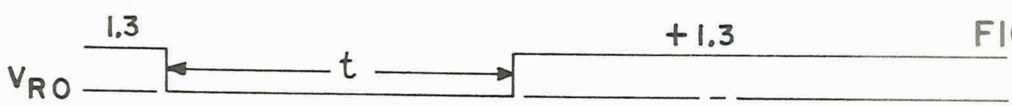


FIG. 3

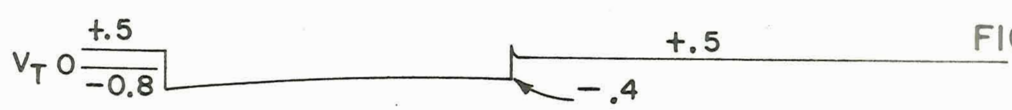


FIG. 4

FIG. 5

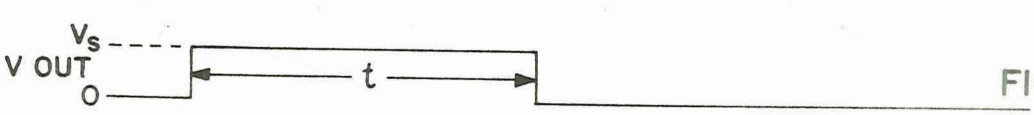


FIG. 6

INVENTOR.
GREGORY L. SCHAFFER

BY

ATTORNEYS

1731

United States Patent

[11] 3,584,311

[72] Inventor Gregory L. Schaffer
Mountain View, Calif.
[21] Appl. No. 799,013
[22] Filed Feb. 13, 1969
[45] Patented June 8, 1971
[73] Assignee The United States of America as represented by the Administrator of the Nation Aeronautics and Space Administration

[54] **MULTIVIBRATOR CIRCUIT WITH MEANS TO PREVENT FALSE TRIGGERING FROM SUPPLY VOLTAGE FLUCTUATIONS**
15 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **328/207,** 307/265, 307/273, 307/288
[51] **Int. Cl.** **H03k 3/10,** H03k 1/18
[50] **Field of Search** 307/265, 273, 288; 328/207, 58

[56] **References Cited**

UNITED STATES PATENTS

3,453,453 7/1969 Hughes 307/273

OTHER REFERENCES

"Noise Immune Multivibrator" by Kolodin, RCA Technical Notes, RCA TN No. 248, Jan. 5, 1959 (Scientific Library)

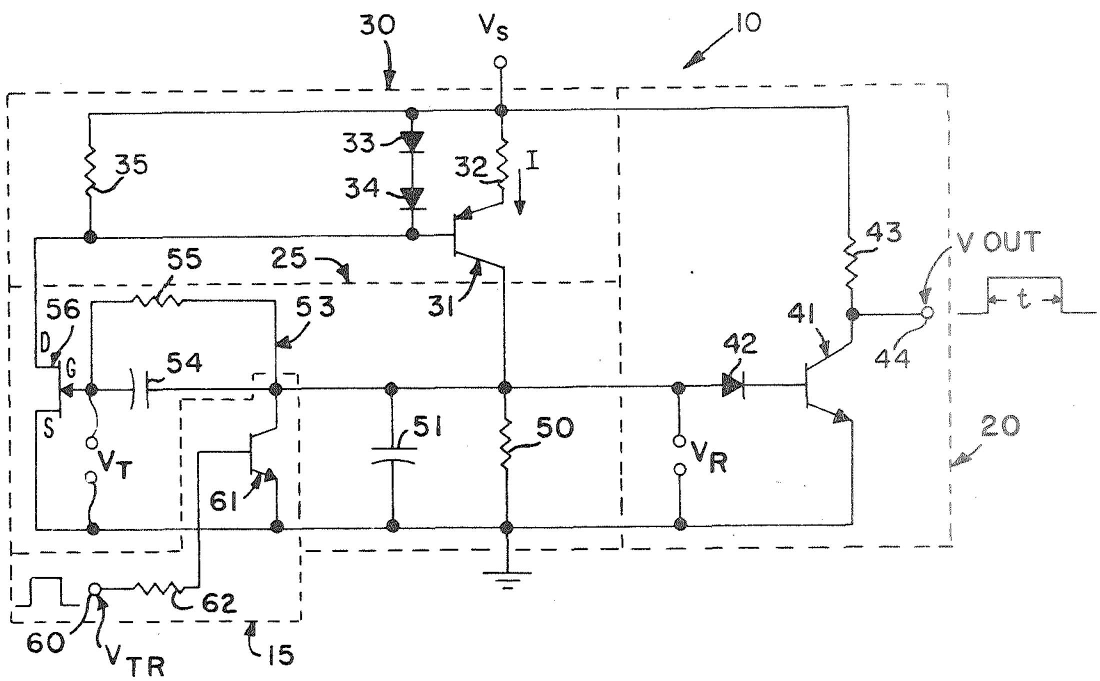
"Coupling Network" by Spiro, IBM TECH DISCLOSURE BULLETING Vol. 6, No. 6, Nov. 1963, page 68

"A ten To One Linear Voltage Controller Pulse Width Circuit" by Torresdale, Motorola Monitor, Vol. 2, No. 3, Copyright 1964 (26)

"Stable High Efficiency Single-Shot Circuit" by Roehr, Jr. et al. IBM Tech Disclosure Bulletin, Vol. 11, No. 4, Sept. 1968, page 352— 353

Primary Examiner—Stanley D. Miller, Jr.
Attorneys—Darrell G. Brekke and G. T. McCoy

ABSTRACT: A one-shot multivibrator that produces long duration output pulses in which there is immunity against false triggering caused by power supply fluctuation or noises. The immunity against false triggering from power supply noises is achieve by a constant current source which provides a constant current independent of fluctuations in the supply voltage for isolating the power supply noise from the timing circuit of the one-shot multivibrator.



MULTIVIBRATOR CIRCUIT WITH MEANS TO PREVENT FALSE TRIGGERING FROM SUPPLY VOLTAGE FLUCTUATIONS

The invention described herein was made by an employee of the United States Government and may be manufactured and used by or for the Government for Governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

The present invention relates in general to one-shot multivibrator circuits, and more particularly to a one-shot multivibrator circuit that produces output pulses of a long duration.

One-shot multivibrators, when triggered, produce output pulses of a fixed duration. When it is desired that the output pulses be of a long duration, the components of the timing circuit thereof are of relatively large values. Thus, the resistance and capacitance components of the RC timing circuit assume large values. As a consequence thereof, noise in the power supply for the one-shot multivibrator tends to pass through the timing circuit to cause erroneous or false triggering of the one-shot multivibrator. Thus, a one-shot multivibrator circuit producing output pulses with long time durations has heretofore been susceptible to false triggering from power supply noise.

Patents considered are U.S. Pat. Nos. 3,374,360; 3,303,353; and 3,277,314. Publication considered is "NASA Tech Briefs," No. B65–10011, published Jan. 1965, article entitled "Circuit Improvement Produces Monostable Multivibrator With Good-Carrying Capability," by Jasten C. Schaffert and Normal E. Goldman.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a one-shot multivibrator circuit that produces long duration output pulses and, yet, has immunity against false triggering from noise in the power supply.

Another object of the present invention is to provide a one-shot multivibrator in which a constant current source isolates the timing circuit of the one-shot multivibrator from the power supply of the one-shot multivibrator to immunize the one-shot multivibrator against erroneous triggering arising out of fluctuations in supply voltage.

Another object of the present invention is to provide a one-shot multivibrator in which a constant current source isolates the timing circuit of the one-shot multivibrator from the power supply of the one-shot multivibrator to immunize the one-shot multivibrator against false triggering arising out of fluctuations in supply voltage and still have output pulses of a long duration.

According to the present invention, a one-shot multivibrator circuit produces output pulses of long duration and comprises a constant current source for isolating the timing circuit from the power supply to obviate false triggering of the multivibrator circuit through fluctuations in the supply voltage.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of a one-shot multivibrator circuit embodying the present invention.

FIG. 2—6 are graphical illustrations of various waveforms of potential and current produced in the one-shot multivibrator circuit shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Illustrated in FIG. 1 is the one-shot multivibrator circuit 10 of the present invention, which comprises an input trigger circuit 15. The input trigger circuit receives a pulse signal to initiate the operation of the one-shot multivibrator circuit 10. Also included in the one-shot multivibrator circuit 10 is an output circuit 20 across which appears the output pulse of a long time duration produced by the one-shot multivibrator circuit 10. A timing circuit 25 for the one-shot multivibrator circuit 10 controls the duration of the output pulse produced across the output circuit 20. Lastly, the one-shot multivibrator circuit 10 comprises a constant current source circuit 30, which serves to immunize or isolate the timing circuit 25 from a source of power having a supply voltage V_s to prevent false triggering of the one-shot multivibrator circuit through fluctuations in the supply voltage V_s. The source of power provides a direct current voltage V_s for the emitter or collector electrodes of the transistors in the circuit depending on the type of transistor employed.

Included in the constant current source circuit 30 is a suitable transistor 31, which in the exemplary embodiment is a 2N3645. The source of direct current voltage V_s is applied to the emitter electrode of the transistor 31 through a suitable resistor 32, which in exemplary embodiment is a 120 ohms resistor. Also, included in the constant current source circuit 30 are diodes 33 and 34 and a resistor 35. The preferred embodiment employs 1N919 diodes and a resistance of 10K ohms for the resistor 35. The resistor 35 stabilizes the constant current source circuit 30 by preventing premature turning on of the transistor 31 from leakage currents. Thus, the transistor 31, the diodes 33 and 34 and the resistors 32 and 35 form the constant current source circuit 30, which provides a constant current I (FIGS. 1 and 5) regardless of fluctuations in the magnitude of the supply voltage V_s.

Connected to the collector electrode of the transistor 31 of the constant current source circuit 30 is the base electrode of a transistor 41 through a diode 42. In the preferred embodiment, the transistor 41 is a 2N3568 and the diode 42 is a 1N914. The transistor 41, the diode 42 and a load resistor 43 form the output circuit 20 for the one-shot multivibrator circuit 10. Output pulses for the one-shot multivibrator circuit 10 are produced across the load resistor 43 and are taken from an output terminal 44. (See FIGS. 1 and 6). In the exemplary embodiment, the load resistor 43 has a resistance of 5.6K ohms.

The current I (FIGS. 1 and 5) supplied to the base of the transistor 41 through the diode 42 is constant during the time the transistor 31 conducts. The transistor 31 of the constant current source circuit 30 is normally conducting. When the transistor 31 is conducting, the output of the transistor 41 taken across the load resistor 43 is low. While the transistor 31 is turned off or is nonconducting, the transistor 41 is turned off or is nonconducting and the output of the transistor 41 as it appears across the load resistor 43 is high. The time duration that the transistor 41 is nonconducting determines the pulse duration t of the output pulses thereof (FIGS. 1 and 6). Thus, it is the precision in controlling the nonconducting time of the transistor 31 that determines the preciseness of the duration of the output pulses produced by the one-shot multivibrator circuit 10.

In the timing circuit 25 is a resistor 50, which is also connected to the collector electrode of the transistor 31. As previously described, the current I supplied from the transistor 31 is constant while the transistor 31 is conducting and, therefore, the current flow through the resistor 50 is constant while the transistor 31 is conducting. By maintaining the current I constant, the direct current voltage appearing across the resistor 50 is maintained constant or is regulated (FIGS. 1 and 3). In the exemplary embodiment, the resistor 50 has a resistance of 470 ohms. In the typical embodiment, the voltage V_R (FIGS. 1 and 3) across the resistor 50 is 1.3 volts. It is held to the regulated voltage by the diode 22 and the base-emitter voltage of the transistor 41.

Also included in the timing circuit 25 and connected in parallel with the resistor 50 is a capacitor 51. In a typical embodiment, the capacitor 51 is 0.01 microfarads. The capacitor 51 serves to prevent misfiring of the one-shot multivibrator circuit 10 from high frequency noise spikes in the supply voltage V_s. The supply voltage V_s is a direct current voltage that is applied to the emitter electrode of the transistor 31 and the collector electrode of the transistor 41.

The timing circuit 25 regulates the duration of the output pulses produced across the load resistor 43 by controlling the nonconducting time of the transistor 31 of the constant current source circuit 30. Also included in the timing circuit 25 is an RC network 53 having a timing capacitor 54 and a timing resistor 55 connected in parallel. The RC network 53 is connected at one end thereof to the gate electrode of a suitable low pinch-off junction field-effect transistor 56 of the timing circuit 55 preferably of the type E101. At the opposite end thereof, the RC network 53 is connected to the resistor 50 and also to the input circuit 15.

The drain electrode of the field-effect transistor 56 is connected to the base electrode of transistor 31 of the constant current source circuit 30. The field-effect transistor 56 is normally conducting. While the field-effect transistor 56 is turned on, the transistor 31 is turned on. Thus, the transistor 31 conducts while the field-effect transistor 56 conducts and, hence, is normally conductive.

The constant or regulated voltage V_R(FIGS. 1 and 3) appearing across the resistor 50 charges the timing capacitor 54 of the RC network 53 so that the positive side thereof is approximately equal to the voltage V_R, which in the exemplary embodiment is 1.3 volts. The negative side of the timing capacitor 54 is more positive than the pinch-off voltage for the field-effect transistor 56. In the typical embodiment, the pinch-off voltage for the field-effect transistor 56 is —0.4 volts (FIG. 4). Thus, the field-effect transistor 56 is normally conducting to keep the transistor 31 of the constant current source circuit 30 normally turned on. The resistor 55 of the RC network 53 is in parallel with the capacitor 54 of the RC network 53 to make the timing interval more independent of the fluctuations in the supply voltage V_s. The resistor 55 should be selected for a resistance value much larger than the resistance value for the resistor 50 for proper operation. In general, it should be greater than 10 V_s R50 in which V_s is the supply voltage, V_R is the constant voltage appearing across the resistor 50 and R50 is the resistance of the resistor 50. The reason for the larger value of the resistance 55 is that the charging current through the capacitor 54, which is also the current flow through the resistor 55 and the resistor 50 should not generate a significant voltage across the resistor 50, thus maintaining the voltage V_R constant or regulated.

The input trigger pulse V_{TR} (FIGS. 1 and 2) is applied to a terminal 60 of the input trigger circuit 15. The input trigger pulse V_{TR} is applied to the base electrode of a suitable transistor 61 through a resistor 62. It is the transistor 61, the resistor 62 and the terminal 60 that constitute the input trigger circuit 15. In the exemplary embodiment, the transistor 61 is a 2N3568 and the resistor 62 has a resistance of 1000 ohms.

When a trigger pulse, such as the trigger pulse V_{TR} (FIGS. 1 and 2) is applied to the terminal 60, the transistor 61 conducts to ground the positive side of the timing capacitor 54. This action puts the negative side of the timing capacitor 54 at a voltage more negative than the pinch-off voltage for the field-effect transistor 56. As a consequence thereof, the gate-to-source voltage of the field-effect transistor 56 is driven sufficiently negative to turn off the transistor 56. In the exemplary embodiment, the gate-source voltage for the field-effect transistor 56 is driven to —0.8 volts (FIG. 4). Thus, the field-effect transistor 56 is nonconducting.

When the field-effect transistor 56 is turned off, the transistor 31 of the constant current source circuit 30 is turned off. While the transistor 31 is turned off, the output of the transistor 41 as it appears across the load resistor 43 is high or at maximum voltage output. With the transistor 31 nonconducting, no voltage appears across the resistor 50 and the resistor 50 serves to hold the positive side of the capacitor 54 to a low voltage.

The triggering pulse V_{TR} (FIG. 1 and 2) is relatively short pulse. After the triggering pulse is completed, the transistor 61 is nonconducting or is turned off. This removes the ground from the positive side of the timing capacitor 54. Now, the negative side of the timing capacitor 54 becomes more positive and reaches a voltage more positive than the pinch-off voltage for the field-effect transistor 56. Thereupon, the field-effect transistor 56 is turned on. In the exemplary embodiment, the time that it takes from the application of the input trigger pulse V_{TR} to the returning of the field-effect transistor 56 to its initial conducting state is controlled by the RC network 53, and constitutes the time duration t (FIGS. 1 and 3) for the output pulses produced by the one-shot multivibrator circuit 10.

When the field-effect transistor 56 starts to conduct, the transistor 31 is turned on which restores the constant or regulated voltage V_{TR} across the resistor 50. The one-shot multivibrator 10 is now prepared for the succeeding input trigger pulse.

It has been found that voltage variations of the supply voltage V_s from 40 volts to 2 volts would not cause a misfire of the one-shot multivibrator circuit 10. Should the voltage output of the supply voltage V_s vary from 40 volts to 4 volts, the timing period t only varies 10 percent.

It is to be observed that in the one-shot multivibrator circuit 10 the current source for supplying a voltage across the timing capacitor 54 is maintained constant by means of the resistor 50, which has the voltage thereacross maintained constant or regulated.

In the operation of the one-shot multivibrator circuit 10, the field-effect transistor 56 is normally conducting. As a consequence thereof, the transistor 31 is normally conducting. The transistor 31 conducts while the field-effect transistor 56 is turned off.

The conduction of the transistor 31 causes the transistor 41 to conduct. Therefore, the output transistor 41 conducts while the transistor 31 is turned on. During this time, the output of the one-shot multivibrator 10 appearing across the load resistor 42 is low (FIGS. 1 and 6).

While the transistor 31 is conducting a constant current I (FIGS. 1 and 5) flows through the resistor 50. Hence, a constant or regulated voltage V_R (FIGS. 1 and 3) appears across the transistor 50. Therefore, the voltage appearing on the positive side of the timing capacitor 54 is maintained constant or regulated. It is the gate-to-source voltage V_T (FIGS. 1 and 4) maintained by the timing capacitor 54 that keeps the field-effect transistor 56 conducting during the steady-state condition. From this arrangement, variations in the voltage of the direct current voltage source V_s would not alter the voltage appearing across the resistor 50 and thereby the voltage on the positive side of the timing capacitor does not change and the gate-to-source potential on the field-effect transistor 56 remains constant. Hence, variations in the direct current voltage from the source V_s will not cause any false firing of the one-shot multivibrator circuit 10.

When a trigger pulse, such as trigger pulse V_{TR} (FIGS. 1 and 2) is applied to the input terminal 60, the transistor 61 conducts to ground the positive side of the timing capacitor 54. This action causes the negative side of the timing capacitor 54 to go negative with the result that the gate-to-source voltage (FIGS. 1 and 4) of the field-effect transistor 56 is more negative than the pinch-off voltage. Thus, the field-effect transistor 56 is turned off. This action turns off the transistor 31 which results in the transistor 41 being turned off. Now, the output of the one-shot multivibrator 10 appearing across the load resistor 43 is at a maximum (FIGS. 1 and 6).

At the end of the trigger pulse V_{TR}, the transistor 61 is turned off to remove the ground from the positive side of the timing capacitor 54. The negative side of the timing capacitor 54 becomes more positive with the result that the field-effect transistor 56 is turned on after a time duration of t (FIG. 1 and 6), which is at the time duration for the output pulses for the one-shot multivibrator 10. Now, the transistor 31 is turned on, which in turn causes the transistor 41 to turn on. The one-shot multivibrator 10 is now prepared for the succeeding trigger pulse.

Having thus described my invention, what I claim as new and desire to protect by Letters Patent is:

1. A multivibrator circuit comprising an output circuit for producing an output pulse, said output circuit being formed with an electron device the conduction of which controls the production of the output pulse, a constant current source circuit connected to said output circuit, said constant current source circuit being formed with an electron device the conduction of which controls the conduction of said electron device for said output circuit in producing the output pulse, a timing circuit connected to said constant current source circuit, said timing circuit being formed with an electron device the conduction of which controls the conduction of said electron device for said constant current source circuit, said timing circuit being formed with a resistance-capacitance network interconnecting said electron device for said timing circuit and said constant current source circuit, said resistance-capacitance network controlling the turning on of said electron device for said timing circuit, said resistance-capacitance network being formed with a capacitor having one electrode thereof connected to said electron device for said timing circuit and the other electrode thereof connected to said constant current source circuit, said timing circuit being formed with a resistor that is connected to said constant current source circuit and has a constant current flowing threrethrough while said electron device for said constant current source circuit conducts to produce thereacross a regulated voltage, said resistor for said timing circuit being connected to said capacitor for said timing circuit for applying the regulated voltage to said capacitor for maintaining said electron device for said timing circuit turned on, and an input trigger circuit connected to said resistance-capacitance network for controlling the turning off of said electron device for said timing circuit, said electron device for said timing circuit being turned off when a trigger pulse is received by said input trigger circuit, said electron device for said timing circuit being turned on after the completion of said trigger pulse and at a time interval controlled by said resistance-capacitance network.

2. A multivibrator circuit as claimed in claim 1 wherein said input circuit includes an electron device the conduction of which controls the voltage applied to said capacitor of said resistance-capacitance network in controlling the conduction of said electron device for said timing circuit.

3. A multivibrator circuit as claimed in claim 1 and comprising a source of direct current voltage which is applied to said electron device for said constant current source circuit and said electron device for said output circuit, and wherein the current flow through said resistor for said timing circuit remains constant during fluctuations of voltage from said source of direct current voltage.

4. A multivibrator circuit as claimed in claim 1 wherein said flow of constant current in said constant current source circuit is applied to said electron device for said output circuit for controlling the conduction thereof.

5. A multivibrator circuit as claimed in claim 2 and comprising a source of direct current voltage which is applied to said electron device for said constant current source circuit and said electron device for said output circuit, and wherein the current flow through said resistor for said timing circuit remains constant during fluctuations of voltage from said source of direct current voltage.

6. A multivibrator circuit as claimed in claim 2 wherein said flow of constant current in said constant current source circuit is applied to said electron device for said output circuit for controlling the conduction thereof.

7. A multivibrator circuit as claimed in claim 3 wherein said flow of constant current in said constant current source circuit is applied to said electron device for said output circuit for controlling the conduction thereof.

8. A multivibrator circuit comprising an output circuit for producing an output pulse, said output circuit being formed with an electron device the conduction of which controls the production of the output pulse, a constant current source circuit connected to said output circuit, said constant current source circuit being formed with an electron device the conduction of which controls the conduction of said electron device for said output circuit in producing the output pulse, a timing circuit connected to said constant current source circuit, said timing circuit being formed with an electron device the conduction of which controls the conduction of said electron device for said constant current source circuit, means in said timing circuit interconnecting said electron device for said timing circuit and said constant current source circuit for controlling the turning on of said electron device for said timing circuit, said timing circuit being formed with a resistor that has a constant current flowing therethrough while said electron device for said constant current source circuit conducts to produce thereacross a regulated voltage, said resistor for said timing circuit being connected to said controlling means for applying the regulated voltage to said controlling means for maintaining said electron device for said timing circuit turned on, and an input trigger circuit connected to said controlling means, said electron device for said timing circuit being turned off when a trigger pulse is received by said controlling means, said electron device for said timing circuit being turned on after the completion of said trigger pulse and at a time interval controlled by said controlling means.

9. A multivibrator circuit as claimed in claim 9 wherein said input circuit includes an electron device the conduction of which controls the voltage applied to said controlling means.

10. A multivibrator circuit as claimed in claim 8 and comprising a source of direct current voltage which is applied to said electron device for said constant current source circuit and said electron device for said output circuit, and wherein the current flow to said controlling means from said constant current source circuit remains constant during fluctuations of voltage from said source of direct current voltage.

11. A multivibrator circuit as claimed in claim 5 wherein said flow of constant current in said constant current source circuit is applied to said electron device for said output circuit for controlling the conduction thereof.

12. A multivibrator circuit as claimed in claim 9 and comprising a source of direct current voltage which is applied to said electron device for said constant current source circuit and said electron device for said output circuit, and wherein the current flow to said controlling means from said constant current source circuit remains constant during fluctuations of voltage from said source of direct current voltage.

13. A multivibrator circuit as claimed in claim 6 wherein said flow of constant current in said constant current source circuit is applied to said electron device for said output circuit for controlling the conduction thereof.

14. A multivibrator circuit as claimed in claim 10 wherein said flow of constant current in said constant current source circuit is applied to said electron device for said output circuit for controlling the conduction thereof.

15. A multivibrator circuit comprising a constant current source circuit, an output circuit connected to said constant current source circuit for producing an output pulse in response to the conduction of said constant current source circuit, a power supply connected to said constant current source circuit and said output circuit for applying voltage thereto, a timing circuit connected over one path to said constant current source circuit for controlling the conduction thereof, said constant current source circuit being connected to said timing circuit over another path to isolate said timing circuit from said power supply to prevent false triggering of said multivibrator circuit through said timing circuit arising out of fluctuations of voltage from said power supply circuit, and an input circuit connected to said timing circuit for controlling the conduction of said timing circuit in response to a trigger pulse.